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IS 8265 (1996): Agricultural tractors - Guards for power take-off (PTO) drive-shafts [FAD 11: Agricultural Tractors and Power Tillers]

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( दूसरा पुनरीक्षण )

*Indian Standard*

AGRICULTURAL TRACTORS — GUARDS FOR  
POWER TAKE-OFF (PTO) DRIVE-SHAFTS  
( *Second Revision* )

ICS 65.060.10;21.120.10

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## FOREWORD

This Indian Standard ( Second Revision ) was adopted by the Bureau of Indian Standards, after the draft finalized by the Agricultural Tractors and Power Tillers Sectional Committee had been approved by the Food and Agriculture Division Council.

Power take-off (PTO) drive shaft is used for coupling the tractor PTO with the implement. With the increased usage of PTO operated implements the manufacture and use of drive shaft has increased. Guards are provided in the drive shafts to ensure safety of the operator.

This standard was first published in 1976 and was revised in 1983. In order to align the test method with corresponding ISO Standard, it has been revised again. This revision incorporate among other the following:

- i) Wear test.
- ii) Modified test conditions and rotational frequency in case of rotating PTO drive shaft guard fixed to 1000 rpm instead of different speeds for different types of shafts as specified in IS 4931:1995.
- iii) Modified test methods for axial loading, radial loading and restraining member.
- iv) Additional axial loading test (optional) at  $-35^{\circ}\text{C}$ .
- v) Figure for strength test and impact test for more clear interpretation.

In the preparation of this standard assistance has been derived from following ISO Standards issued by the International Organization for Standardization :

ISO 5674-1-1992(E) ‘Tractor and machinery for agricultural and forestry — Guards for PTO drive shaft, Part 1 Strength test’.

ISO 5674-2-1992(E) ‘Tractor and machinery for agricultural and forestry — Guards for PTO drive shaft, Part 2 Wear test’.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## *Indian Standard*

# AGRICULTURAL TRACTORS — GUARDS FOR POWER TAKE-OFF (PTO) DRIVE-SHAFTS

## *(Second Revision)*

### **1 SCOPE**

This standard prescribes the test methods and requirements for determining the robustness, durability and resistance against wear of guards of power take-off (PTO) drive shafts.

### **2 REFERENCES**

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
9939 : 1981	Glossary of terms related to agricultural tractors and power tillers
10318 : 1992	Technical requirements for power take off drive shafts for agricultural tractors and machines
12239 (Part 1) : 1988	Guide for safety and comfort of operator of agricultural tractors and power tillers: Part 1 General requirements

### **3 DEFINITIONS**

For the purpose of this standard the following definitions shall apply.

**3.1 PTO Drive-Shaft** — See 6.7 of IS 9939:1981.

**3.2 Shaft Closed Length** — See 2.1.1 of IS 10318:1992.

**3.3 Shaft Extended Length** — See 2.1.2 of IS 10318:1992.

**3.4 Non-rotating PTO Drive-Shaft Guard** — PTO drive shaft guard held stationary while the shaft is rotating.

**3.5 Rotating PTO Drive-Shaft Guard** — PTO drive-shaft guard which can rotate with the shaft except when it comes into contact with some other object.

### **4 TEST CONDITIONS**

**4.1** The guard, shall be taken from production and within the tolerance shown on production drawings.

The operating and maintenance instructions shall be complied with as described by the manufacturer. The guard shall be tested in conjunction with a PTO drive-shaft of 1 m closed length (see 3.2) for which it is intended. The same guard shall be used throughout the test. The results obtained from a sample shall be presumed to be valid for guards of shorter and longer length.

**4.2** When the guard is made of plastics material it is assumed to have been certified by the manufacturer to be resistant to UV-radiation.

**4.3** Tests shall be carried out at an ambient temperature between 5°C and 35°C, except as specified.

**4.4** Where a test procedure requires the shaft to be rotated the rotational frequency shall be 1 000 rev/min.

### **5 STRENGTH TESTS**

#### **5.1 General**

The guard shall be subjected to the appropriate tests given in 5.2 to 5.6 following the test sequence given. After each test, note and record the condition of the guard with particular reference to any fractures, permanent deformation or detachments of components.

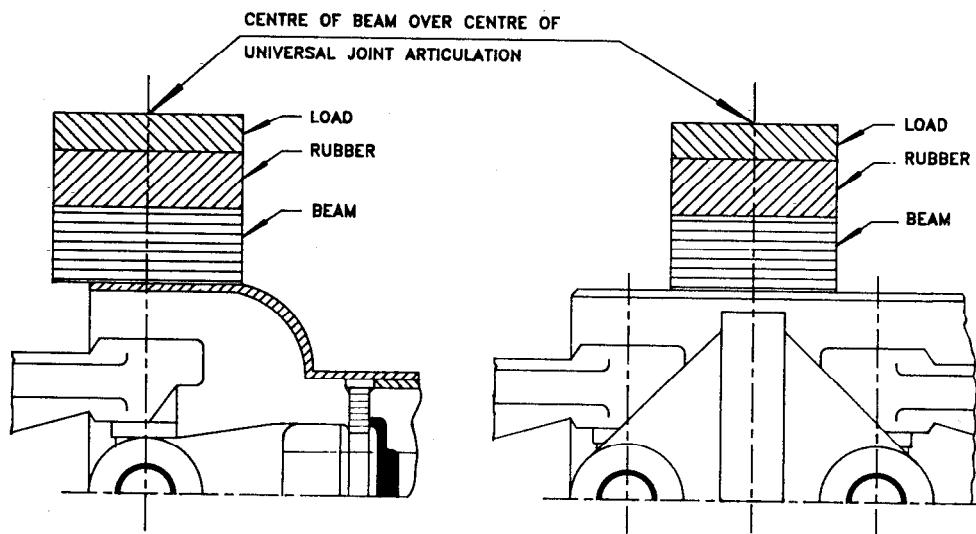
#### **5.2 Axial Loading Test at Ambient Temperature**

With the PTO drive-shafts and guard stationary, apply an axial force of 250 N between the cone and the tube in both directions. The force shall be gradually applied and then held for a minimum of 60 s. If the cones, or method of attaching them to the tubes, are not the same, each cone end shall be tested.

#### **5.3 Radial Loading Test at Ambient Temperature**

**5.3.1** Support the guarded PTO drive-shaft in a horizontal straight line by its usual end connections, extended to the maximum length recommended by the manufacturer.

**5.3.2** Rotate the PTO drive-shaft and using a smooth flat 100 mm wide wooden beam, apply a direct load of 500 N for 60 s at right-angles to the shaft guard at its mid-point.



1A) Beam Position for Single Universal Joint

1B) Beam Position for Centred Double Universal Joint

FIG. 1 RADIAL LOAD TEST OF CONE

To avoid excessive vibration, the wooden beam shall be supported by a 20 mm thick rubber backing of approximately A/20 shore hardness (see Fig. 1).

When applying the load, care shall be taken to ensure that no impact load is applied.

**5.3.3** Rotate the PTO drive-shaft and, using the wooden beam described in **5.3.2**, apply a direct force of 500 N to the cone over the centre of the articulation of the universal joint, when in line with the PTO drive-shaft, for 60 s as shown in Fig. 1. The force shall be applied perpendicular to the PTO drive-shaft.

If the method of attachment of the guard to the shaft is not identical at each end, then test both ends.

**5.3.4** Record whether any additional part of shaft was exposed during or after the test.

#### 5.4 Axial Loading Test at Freezing Temperature (Optional)

**5.4.1** Lower the temperature to  $-35^{\circ}\text{C}$  and maintain the PTO drive-shaft and guard at that temperature for 1 h.

**5.4.2** With the PTO drive-shaft and guard stationary and at  $-35^{\circ}\text{C}$  apply an axial force between the guard and the PTO drive-shaft in both directions. The force shall be:

- 2.5 kN if the inner diameter of the outer guard tube is less than or equal to 80 mm.
- 3.5 kN if the inner diameter of the outer guard tube is more than 80 mm.

The force shall be applied on the PTO shaft while the guard is held stationary.

If the method of attachment of the guard to the shaft is not the same at each end, each end shall be tested.

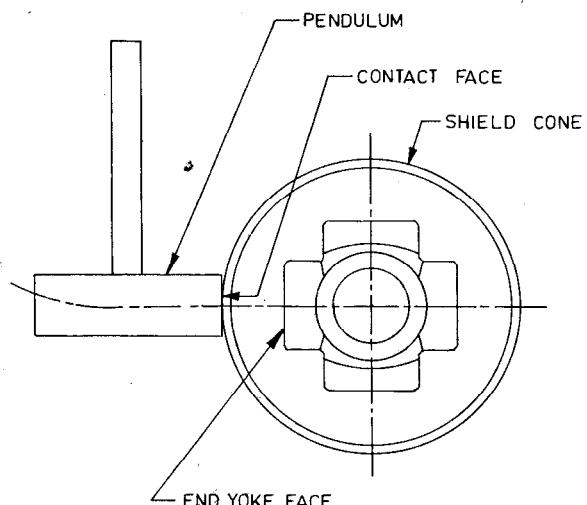
#### 5.5 Impact Test

**5.5.1** Support the PTO drive-shaft and guard in a horizontal straight line by their normal connections, extended to the maximum length recommended by the manufacturer.

**5.5.2** Maintain the PTO drive-shaft and guard at ambient temperature (see Note under **5.5.3**) for one hour.

**5.5.3** With the PTO drive-shaft and guard at ambient temperature (see Note) strike three blows as follows:

- One on the cone over the centre of articulation of the universal joint when in line with the PTO drive-shaft (the position of the end yoke being such that the face of the yoke is parallel to the contact face (see Fig. 2);



- b) One midway along on one of the tubes; and
- c) One at the midpoint of the overlap of the tubes.

The blows shall be struck by using a pendulum, so that the impact energy is 98 J. The contact face shall be flat and have a diameter of 50 mm (see Fig. 2).

NOTE — If required by the purchaser, the above test may be conducted at a temperature of  $-35^{\circ}\text{C}$ .

### **5.6 Restraining Member Test at Ambient Temperature**

**5.6.1** Apply a force of 400 N to each fitted restraining member. The force shall be applied perpendicular to, and in the same plane as the axis of the PTO drive-shaft.

**5.6.2** Record any function failure of the straining member of opening of the fixing hooks and any fracture or cracks of the guard for detachment of the guard component.

### **5.7 Requirements**

The PTO drive-shaft guard is deemed to have passed the tests if the damage (if any) does not impair the general safety requirements imposed on the guard by the requirements of IS 12239 (Part 1):1988.

A restraining member, where fitted, shall not show any permanent deformation impairing its function; there shall be no holes caused by wear during the test.

### **5.8 Test Report**

**5.8.1** The test report shall include the following details:

- a) Details of PTO drive-shaft guard, including identification marks for the guard and PTO drive-shaft;
- b) Condition of the guard after each test (see 5.1);
- c) Results of axial loading test at ambient temperature (see 5.2);
- d) Results of radial loading test at ambient temperature (see 5.3);
- e) Results of axial loading test at freezing temperature (optional) (see 5.4);
- f) Results of Impact test at ambient/freezing temperature (see 5.5);
- g) Results of restraining member test at ambient temperature (see 5.6), if applicable; and
- h) Statement if guard meets the requirements of 5.7.

**5.8.2** A typical test report is shown in Annex A.

## **6 WEAR TEST**

### **6.1 General**

If this wear test is to be carried out it shall be undertaken on the same guard but before the strength test (see 5). Non-rotating guards shall be restrained from rotating during the tests. Rotating guards shall not be restrained from rotating.

### **6.2 Test Equipment**

**6.2.1** The wear test equipment shall consist of a cabinet capable of holding the PTO drive-shaft and the rotating or non-rotating guard horizontal, and of rotating the PTO drive-shaft at a frequency of 1 000 rev/min. The equipment shall be such that it can be used for all PTO drive-shafts as specified in IS 10318:1982.

The size and shape of the cabinet shall be such that an even distribution of the spray of salt-water solution or dust is ensured. The upper parts shall be shaped so that drops of sprayed solution which accumulate on them do not fall onto the PTO drive shaft guard.

**6.2.2** When the tests require the use of water, the water shall be potable.

**6.2.3** The dust shall consist of a mixture composed of equal parts, by mass, of organic and mineral dust.

**6.2.3.1** The organic dust shall be ground lucerne with a maximum percentage of 12 percent water and with a maximum particle size of 2 mm.

**6.2.3.2** The mineral dust shall be a simple phosphated fertilizer. This product is obtained during the production of steel, by the treatment of steel or of phosphorous cast iron. It contains, as principal elements, the silicophosphates of calcium having the following characteristics:

Minimum content	12 percent of $\text{P}_2\text{O}_5$ total ,
Other	75 percent at least of the $\text{P}_2\text{O}_5$ total declared and shall be soluble in 2 percent concentration of citric acid
Mesh opening of sieve	The fineness of grinding, after sifting
>0.063 mm	—
>0.125 mm	—
>0.16 mm	>75 percent, Min (m/m)
>0.63 mm	>96 percent, Min (m/m)

**6.2.4** When using salt-water solution, it shall be prepared by dissolving sodium chloride in water to produce a concentration of  $50 \text{ g/l} \pm 5 \text{ g/l}$ . The sodium chloride shall be white and shall give a colourless solution in water. It shall be substantially free from copper and nickel, and shall not contain more than 0.1 percent of sodium iodide and not more than 0.4 percent of total impurities calculated for dry salt.

The solution shall be filtered before it is used in the test in order to remove any solid matter which might block the apparatus of the spraying device.

### 6.3 Method of Test

During a complete test, the guard with shafts is operated for 290 h.

**6.3.1** During operation in test sequence described in **6.3.2**, the shaft shall be rotated and, while rotating, shall be extended to its maximum length for 1 min of each 5 min cycle, and held at its minimum length for the other 4 min.

**6.3.2** The test consists of the following four parts:

- For 120 h, operate in alternating 24 h cycles at  $50^\circ\text{C}$  and at ambient temperature, commencing with a cycle at  $50^\circ\text{C}$ .

Immediately before commencing the next part of the test, immerse the PTO drive-shaft with guard in water (*see 6.2.2*), remove from the water and allow any water which may run off under gravity to do so.

- For 120 h, operate at ambient temperature in an atmosphere containing  $0.5 \text{ kg/m}^3$  of dust as specified in **6.2.3**.
- For 2 h, operate at ambient temperature in an atomized solution of salt-water (*see 6.2.4*) sprayed at a rate of  $72(1/\text{h})/\text{m}^2$ . After the 2 h of operating, leave the PTO drive-shaft with guard, stationary for 46 h.
- For 48 h, operate at ambient temperature.

**6.3.3** Before the start and at the end of the test described in **6.3.2**, measure the running torque which needs to be applied to each guard tube in order to immobilize it while the shaft rotates at 1 000 rev/min.

### 6.4 Radial and Axial Loading Tests

**6.4.1** After completion of the wear test, the guarded PTO drive-shaft shall be subjected to a radial loading test at ambient temperature as described in **5.3**.

**6.4.2** The guarded PTO drive-shaft shall also be subjected to an axial loading test at ambient temperature. With the PTO drive-shaft and guard stationary, apply an axial force of 1 000 N between each guard tube and the PTO drive shaft. Apply the force in both directions.

**6.4.3** After the loading tests in **6.4.1** and **6.4.2** note and record the condition of the guard, particularly concerning any wear, fractures, permanent deformations or attachment of components.

### 6.5 Requirements

The PTO drive-shaft guard is deemed to have passed the tests if:

- before and after the wear test, the torque required for the immobilization of any part of the non-rotating guard when the shaft rotates is not greater than 2.5 N·m;
- after the loading tests, the damage, if any, does not impair the general safety requirements imposed on the guard by the requirements of IS 12239 (Part 1) : 1988 and no holes have been caused by wear.

### 6.6 Test Report

**6.6.1** The test report shall include the following details:

- Details of PTO drive-shaft guard, including identification marks for the guard and the PTO drive-shaft;
- For non-rotating guards, the torque in newton meters, before the start and at the end of the wear test, needed to immobilize each guard tube when the shaft rotates (*see 6.3.3*);
- Results of the loading tests (*see 6.4.3*); and
- Statement if the guard meets the requirements of **6.5**.

**6.6.2** A typical test report is shown in Annex B.



Did guard remain stationary during the 60s period for:

Non-rotating guards? Yes/No (delete as applicable)

Rotating guards? Yes/No (delete as applicable)

Was any additional part of the shaft exposed during or after the test? Yes/No (delete as applicable)

Comments, if any .....

.....

.....

#### Axial loading test at freezing temperature (optional)

Freezing temperature ..... °C

Did guard remain functional? Yes/No (delete as applicable)

Did guard remain located on shaft? Yes/No (delete as applicable)

Comments, if any .....

.....

.....

#### Impact test at ambient/freezing temperature

Ambient/freezing temperature ..... °C

Did guard remain functional? Yes/No (delete as applicable)

Comments, if any .....

.....

.....

#### Restraining member test

Ambient temperature ..... °C

Did restraining member remain functional? Yes/No (delete as applicable)

Comments, if any .....

.....

.....

Did guard meet the requirements of 5.7? Yes/No (delete as applicable)

## ANNEX B

(Clause 6.6.2)

### FORM OF TEST REPORT

#### Wear test of guards for PTO drive-shafts

Report on test of..... power take-off drive-shaft guard mounted on  
..... power take-off drive-shaft

closed ..... mm

Length of shaft

extended ..... mm

Identification mark on shaft .....

Guard: non-rotating/rotating (delete as applicable)

Identification mark on guard .....

**Cones**

Material .....

Length ..... mm

Maximum diameter ..... mm

**Tubes**

Material .....

**Dimensions**

Outside diameter

Wall thickness

Length

Outer tube ..... mm ..... mm ..... mm

Inner tube ..... mm ..... mm ..... mm

Method of location on shaft .....

Type of bearings .....

Other feature .....

Did the torque needed to immobilize the non-rotating guard while the shaft rotated exceed 2.5 N·m:

Before the wear test? Yes/No (delete as applicable)

After the wear test? Yes/No (delete as applicable)

Comments, if any .....

.....

**Radial loading test at ambient temperature**

Ambient temperature ..... °C

Did guard remain stationary during the 60s period for:

Non-rotating guards? Yes/No (delete as applicable)

Rotating guards? Yes/No (delete as applicable)

Was any additional part of the shaft exposed during or after the test? Yes/No (delete as applicable)

Did guard remains functional? Yes/No (delete as applicable)

Comments, if any .....

.....

**Axial loading test at ambient temperature**

Ambient temperature ..... °C

Did guard remain functional? Yes/No (delete as applicable)

Did guard remain located on shaft? Yes/No (delete as applicable)

Comments, if any .....

.....

Did the guard meet the requirements of 6.5? Yes/No (delete as applicable)

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This Indian Standard has been developed from Doc : No. FAD (32) 345.

## **Amendments Issued Since Publication**

Amend. No.	Date of Issue	Text Affected

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